Add a'

CLAIMS

1. A microelectronic device having a region (14) between electrodes (12, 16) with switchable ohmic resistance, wherein the ohmic resistance in said region (14) is reversibly switchable between different states (1, 2, 3, 4) by applying different voltage pulses (5, 5.1, 6, 6.1, 7, 8) leading to said different states (1, 2, 3, 4) and wherein said region (14) is made of a substance comprising components A_x, B_y, and oxygen O_z, in which substance
said component A is a member of Alkaline metals (group IA), or Alkaline Earth metals (group IIA), or Rare Earth elements, or Scandium, or Yttrium,
said component B is a transition metal being member of one of the groups IB to VIII, or a member of one of the groups IIIA, IVA, VA,
said substance comprises a dopant of one of or a combination of different transition metals, the total dopant amount being larger than 0% and smaller than 5%.

2. The microelectronic device according to claim 1, wherein the ohmic resistance in the region (14) is switchable between at least a first state (1) of the different states and a second state (2) of the different states by applying to the electrodes (12, 16) a first voltage pulse (5.1) of the different voltage pulses for switching from said second state (2) to said first state (1) or a second voltage pulse (6.1) of the different voltage pulses for switching from said first state (1) to said second state (2).

3. The microelectronic device according to claim 2, wherein the ohmic resistance in the first state (1) is higher than in the second state (2) and wherein the first voltage pulse (5.1) of the different voltage pulses for switching to said first state (1) has an opposite sign to the second pulse (6.1) of the different voltage pulses for switching to said second state (2).

4. The microelectronic device according to claim 1, wherein each of the different states (1, 2, 3, 4) is obtainable by an erase pulse (5) for switching the ohmic resistance in the region (14) to a high ohmic state (1) of the different states and/or at least one write pulse (6, 7, 8) for switching from said high ohmic state (1) to a lower ohmic state (2, 3, 4) of the different states .

5. The microelectronic device according to claim 4, wherein the erase pulse (5) has different amplitudes for switching to one of the lower ohmic states (2, 3, 4).

6. The microelectronic device according to one of claims 1 to 4, wherein the different states (1, 2, 3, 4) are readable by a read voltage (9) smaller in magnitude than the different voltage pulses (5, 5.1, 6, 6.1, 7, 8) applied for switching to the different states (1, 2, 3, 4).

7. The microelectronic device according to claim 1 being usable as a capacitor-like structure, wherein the region (14) represents a dielectric.

8. The microelectronic device according to claim 1, whereby a specific ohmic resistance of the region (14) related to one of the different states (1, 2, 3, 4) remains after one of the different voltage pulses (5, 5.1, 6, 6.1, 7, 8) that leads to said specific ohmic resistance has been applied to the electrodes (12, 16).

9. The microelectronic device according to one of the preceding claims being able to store digital information that is representable by different values in ohmic resistance of the region (14), thereby preferably storing two or more bits as digital information.

10. The microelectronic device according to claim 1, in which the combinations of indices x, y and z of the substance are definable by

$x = n + 2, y = n + 1, z = 3n + 4$, with $n = 0, 1, 2, 3$; or

$x = n + 1, y = n + 1, z = 3n + 5$, with $n = 1, 2, 3, 4$.

11. The microelectronic device according to claim 1, in which the combinations of indices x, y and z of the substance are definable by either of:

$x = 1$, $y = 1$, $z = 1$, and one of the indices x or y being 0; or

$x = n$, $y = n$, $z = n + 1$, with $n = 1$ or 2 and one of the indices x or y being 0; or

$x = n$, $y = n$, $z = 2n + 1$, with $n = 2$ and one of the indices x or y being 0.

12. The microelectronic device according to claim 1, in which the combinations of indices x, y and z of the substance are definable by

$x = n$, $y = n$, $z = 3n$, with $n = 1$, or 2, or 3; or

$x = n + 1$, $y = n$, $z = 4n + 1$, with $n = 1$, or 2.

13. The microelectronic device according to claim 1, comprising a dopant of Chromium or Vanadium at an amount larger than 0% and smaller than 5%, preferably about 0.2%.

14. The microelectronic device according to claim 1, wherein at least one of the components A_x or B_y of the substance comprises a combination of elements out of one group or out of several of the corresponding groups of A, and B, respectively.

15. The microelectronic device according to claim 11, wherein the substance is present in the form of a superlattice made by a combination of structural unit cells and/or sub-unit cells.

16. The microelectronic device according to claim 10 or 12, wherein the substance is present in the form of a superlattice made by a combination of structural unit cells and/or sub-unit cells having each a different n, said structural unit cells and/or sub-unit cells being each a member of a corresponding homologous series.

17. A memory cell arrangement comprising a microelectronic device according to one of the preceding claims 1 to 16.

18. A semiconductor device comprising a microelectronic device according to one of the preceding claims 1 to 16.

19. A method for writing information into a memory cell arrangement according to claim 17 comprising the step of:
applying one voltage pulse of the different voltage pulses (5, 6, 7, 8) to the electrodes (12, 16) of said memory cell arrangement for writing information into it.

20. The method according to claim 19, wherein the ohmic resistance in the region (14) is switched between at least a first state (1) of the different states and a second state (2) of the different states by applying to the electrodes (12, 16) a first voltage pulse (5.1) of the different voltage pulses for switching from said second state (2) to said first state (1) or a second voltage pulse (6.1) of the different voltage pulses for switching from said first state (1) to said second state (2).

21. The method according to claim 20, wherein the ohmic resistance in the first state (1) is higher than in the second state (2) and wherein the first voltage pulse (5.1) for switching to said first state (1) has an opposite sign to the second voltage pulse (6.1) for switching to said second state (2).

22. The method according to claim 19, wherein each of the different states (1, 2, 3, 4) are obtained by an erase pulse (5) for switching the ohmic resistance in the region (14) to a high ohmic state (1) of the different states and/or at least one write pulse (6, 7, 8) for switching from said high ohmic state (1) to a lower ohmic state (2, 3, 4) of the different states corresponding to said write pulse (6, 7, 8).

23. The method according to claim 22, wherein the erase pulse (5) has different amplitudes for switching to one of the lower ohmic states (2, 3, 4).

24. A method for reading information out of a memory cell arrangement according to claim 17 comprising the steps of:
applying a read voltage (9) to said memory cell arrangement and
associating with this information a value of current flowing through said memory cell arrangement; or
applying a current pulse to said memory cell arrangement and
associating with this information a value of voltage appearing between the electrodes (12, 16) of said memory cell arrangement.

25. Use of a substance comprising components A_x, B_y, and oxygen O_z, for making a region (14) having a switchable ohmic resistance within a capacitor-like structure, in which substance
said component A is a member of Alkaline metals (group IA), or Alkaline Earth metals (group IIA), or Rare Earth elements, or Scandium, or Yttrium,
said component B is a transition metal being member of one of the groups IB to VIII, or a member of one of the groups IIIA, IVA, VA,
said substance comprises a dopant of one of or a combination of different transition metals, the total dopant amount being larger than 0% and smaller than 5%.

26. Use of a substance according to the preceding claim, whereby the combinations of indices x, y and z are defined by
$x = n + 2$, $y = n + 1$, $z = 3n + 4$, with $n = 0, 1, 2, 3$; or
$x = n + 1$, $y = n + 1$, $z = 3n + 5$, with $n = 1, 2, 3, 4$; or
being defined by either of:
$x = 1$, $y = 1$, $z = 1$, and one of the indices x or y being 0, or
$x = n$, $y = n$, $z = n + 1$, with $n = 1$ or 2 and one of the indices x or y being 0, or
$x = n$, $y = n$, $z = 2n + 1$, with $n = 2$ and one of the indices x or y being 0; or
being defined by
$x = n$, $y = n$, $z = 3n$, with $n = 1$, or 2, or 3; or
$x = n + 1$, $y = n$, $z = 4n + 1$, with $n = 1$, or 2.